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REPORT OF FINDINGS: KODIAK NATIONAL  
WILDLIFE REFUGE CONTAMINANTS STUDY

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## INTRODUCTION

During World War II, the Kodiak Naval Reservation (Figures 1 and 2) was rapidly expanded to thwart threats of a Japanese invasion. Bunkers, fuel tanks, and sophisticated electronics equipment, in addition to housing and support structures, were erected in strategic locations in and near the city of Kodiak. Due to the urgency of the fortification and the top secret nature of some projects, plans weren't always prepared beforehand nor were maps always made of the military developments. Consequently, when the Kodiak National Wildlife Refuge headquarters and adjoining residences were built in 1982 on these lands leased from the military, historical information was incomplete. Although wartime records are scant, a 1943 map depicts numerous buildings, a radio receiving station, a filter and gas tanks in the area where the U.S. Fish and Wildlife Service headquarters and residences are now located. None of these structures is discernible at the present time, so it is not known if they were only planned, were removed after the war, and/or have been camouflaged by vegetation.

Three known seep areas exist near the headquarters building and are of concern. Any contaminants in the seeps may pose health and/or safety hazards to people, as well as to wildlife and fisheries.

In addition to these seep areas, the potable water supply for the headquarters is susceptible to potential contamination from military waste and/or pesticides. Various World War II structures, and waste disposal sites are located in the Buskin River watershed above Buskin Lake, the potable water supply source for the U.S. Fish and Wildlife Service Headquarters. At a minimum, there is a 55-gallon drum storage area, several munitions bunkers, and an old covered dump site in the watershed above the lake. The Coast Guard has also erected several communication towers in this vicinity. Any or a combination of these items could be contributing contaminants to Buskin Lake.

Pesticides may also enter Buskin Lake from any insect-abatement activities on the adjacent Coast Guard golf course. The Coast Guard has proposed spraying malathion and pyrethrin on the golf course in the past. The status of this proposal is unknown, but the golf course is merely 1/2 mile from, and is upstream of, Buskin Lake.

### Study Area

Figures 1 and 2 show the general location of the Refuge; figure 3 shows locations of the sample sites. Seep area number 1 is located adjacent to the Visitor Center parking lot and could pose a threat to members of the public visiting the Headquarters. It

drains at an unknown but low volume into Lake Louise via a culvert under Rezanof Drive West, which is bordered by U.S. Coast Guard housing. Any contaminants could thus pose a threat to these people. In addition, seagulls utilize the lake as a roosting site and bald eagles are frequently seen flying over the lake presumably in search of food. Lake Louise drains into the Buskin River, which is a valuable fisheries stream. In 1985 for instance, 167,693 pink, 18,010 sockeye and 9,266 silver salmon were counted at the Buskin River weir which lies downstream from Lake Louise. Thus contaminants from this seep could be impacting fisheries and wildlife as well as people.

Seep areas number 2 and number 3 are located near the Headquarters shop and near the residences, respectively. Both flow intermittently at low volumes, but occasionally display discolored waters. If contaminants were present they could pose a hazard to refuge employees, their families and family pets. These seep areas do not flow into the Buskin River but instead flow onto level ground where they presumably permeate into the aquifer. The origin of the seep sites is presently unknown.

Sample area number 4 is the control area immediately northwest of the Headquarters building.

Two separate grab samples were taken of drinking water in the Headquarters building (from faucet in the conference/break room).

### Field Procedures

At each site three composite sediment samples were taken for total metals analyses - once during a relatively dry period, and once during a relatively wet period. All sediment and soil samples for metals analyses were collected with plastic utensils, mixed in plastic trays, and stored in 250-ml polyethylene jars. All sampling tools were cleaned with de-mineralized water between samples to prevent cross-contamination. All sediment and soil samples for organic analyses were collected using acetone-rinsed stainless steel utensils, mixed in aluminum foil lined trays, and placed in acid-rinsed 250-ml glass jars with Teflon-lined covers. All samples were refrigerated immediately after collection, and remained cooled until analyses.

The water line was flushed for five minutes prior to sampling. The water samples for metal analyses were collected in 950-ml polyethylene jars with Teflon-lined covers, filtered with a 0.45-micron filter, and preserved with concentrated, pure nitric acid. Water samples for organic analyses were collected in a similar fashion, but stored in pre-cleaned, 950-ml glass jars. All samples were refrigerated immediately after collection, and remained cooled until analyses.

## Analytical Procedures

Standard techniques of atomic absorption and inductively coupled plasma spectrometry were utilized by the Research Triangle Institute to determine concentrations of metals. Organochlorines and polycyclic aromatic hydrocarbons (PAHs) were analyzed by Texas A and M Research Foundation. Table 1 lists all the chemical compounds and inorganics analyzed. The lower level of detection for the polychlorinated biphenyls (PCBs) is 0.5 parts per million (ppm); that for all other organochlorines is 0.02 ppm. The detection limit for PAHs is 0.01 ppm. Detection levels for inorganic elements vary for each sample and element.

All PAHs and organochlorine concentrations are expressed in ppm and were determined on a wet weight (ww) basis. Inorganic values are also expressed in ppm, but were determined on a dry weight (dw) basis, unless otherwise indicated.

The quality assurance report of the U.S. Fish and Wildlife Service's Patuxent Laboratory stated that the accuracy of all analyses were generally acceptable; however, the confidence is low for antimony, silver and tin due to their low recovery. The recovery of magnesium was so low that they stated the data were unusable.

## RESULTS

Complete sets of raw data are on file at the Kodiak National Wildlife Refuge and the Ecological Services Anchorage offices. All raw data for metals are tabulated by element in Table 2. In only a few cases was an organic compound detectable at all. In all such instances, the level was quite low; hence the raw data are not reproduced in this report.

### Organochlorines

Organochlorine analytes were not detected in any sample.

### Polycyclic Aromatic Hydrocarbons

All samples contained undetectable or negligible quantities of PAHs.

### Inorganics

Tabulated raw data for relevant trace metals are displayed in Table 2. Most analyte concentrations are within normal ranges. However, several metals (chromium, lead, zinc) from site 1 are slightly elevated, and the concentration of manganese is notably raised (compared to background). Concentrations at all other sites, including the drinking water at the headquarters building, fall within our criteria.

## DISCUSSION

### Data Interpretation

The process of interpreting chemical analyses is aimed at addressing the question "Do the sample data indicate a problem exists?" In its simplest form this act would appear to consist of comparing each sample datum with a list of action levels or threshold levels (= criteria), above which a problem - albeit undefined - exists. Indeed, this would be ideal. However, a variety of problems impede this approach.

In the case of water and soil/sediment, the total amount of a chemical reported for a sample is not synonymous with the amount that is (biologically) available. The latter is strongly influenced by a complex suite of physical, chemical and biological factors (e.g. pH, Eh, hardness, alkalinity, salinity, concentration of organic matter, texture). One never has all relevant information for each sample that would allow adjustment of calculated values prior to comparison with a list of criteria (Long and Morgan, 1990; Shea, 1988).

In the case of tissue samples, a different criterion may exist for each species, as well as the particular tissue within that species (e.g. liver vs. kidney vs. muscle vs. whole body homogenate). Moreover, a sublethal criterion (e.g. avoidance, impaired growth, impaired reproductive success) is much lower than a criterion for safe consumption levels or acute mortality. These and other problems with developing a single set of rigid criteria are thoroughly discussed in Long and Morgan (1990) and Soholt, et al (1981). Nevertheless, an arbitrary set of criteria has been subjectively constructed by amalgamating a variety of information including: Environmental Protection Agency's water quality criteria; review papers/series that offer lists of "action levels;" U.S. Food and Drug Administration's action levels for poisonous or deleterious substances in human food; World Health Organization's list of water quality criteria; and sundry literature dealing with some sort of biological effect of one, a few, or a group of individual chemicals. As many of the above sources as time allowed were reviewed prior to finalizing the criteria (Appendix A).

The approach to interpretation consists of a 4-step process, essentially comparing each laboratory-reported value to a series of screens:

1. Background or control samples taken from the study area
2. The subjective set of criteria (Appendix A)
3. Literature values listing averages and ranges for Alaska (Gough, et. al, 1988)

4. Literature values listing averages and ranges on a worldwide basis (Fortescue, 1980)

In general, we did not consider a sample value problematical unless it exceeded one order of magnitude of the appropriate screen(s). This is a common strategy designed to provide a buffer for a variety of sources of inherent variance, principally site specificity and laboratory methodology.

Exceedance of Action Levels

Sediment. Chromium exceeded our action level (Appendix A) in sample BK001S only. This is likely an anomaly given that no other replicate exceeded the action level. Lead exceeded our action level in three of six replicates from site 1. Zinc exceeded our action level in all samples from site 1, but in no case did it exceed the action level by an order of magnitude or greater. Manganese appears to be the most elevated of all elements, but only at site 1; all six replicates from this site exceed our action level by more than an order of magnitude.

The cause of these elevations at site 1 is unknown. High levels of these particular elements may be indicative of leaching of buried metal objects. Anecdotal information indicates that unknown solid fill material was deposited in the vicinity prior to construction of the refuge headquarters building. It is emphasized that this explanation of elevated values for zinc, lead and manganese is an hypothesis only.

Water. Most analytes were undetectable in water samples. In no case were Alaskan drinking water standards exceeded.

CONCLUSIONS AND RECOMMENDATIONS

Site 1 is the only study area that contains elevated concentrations of several metals, including lead, zinc, and manganese. All other sites (and the drinking water) are of no concern. Although the levels detected at site 1 do not indicate gross contamination requiring immediate action, they do exceed our criteria, and thus deserve attention. If this seep persists over an extended period of time, it could affect the fish and wildlife resources of the receiving water body(ies). Measures should be taken to prevent the public (as well as pets and wildlife) from contacting the seep. At a minimum, it will be prudent to conduct additional monitoring on a regular schedule (every two or three years) to determine the trend(s) of metal concentrations. A decision to remediate the seep (i.e. discover and remove the cause) should be based on those future findings. Prior to future sampling, your staff must submit a study plan to the Regional Contaminants Coordinator to secure funding.

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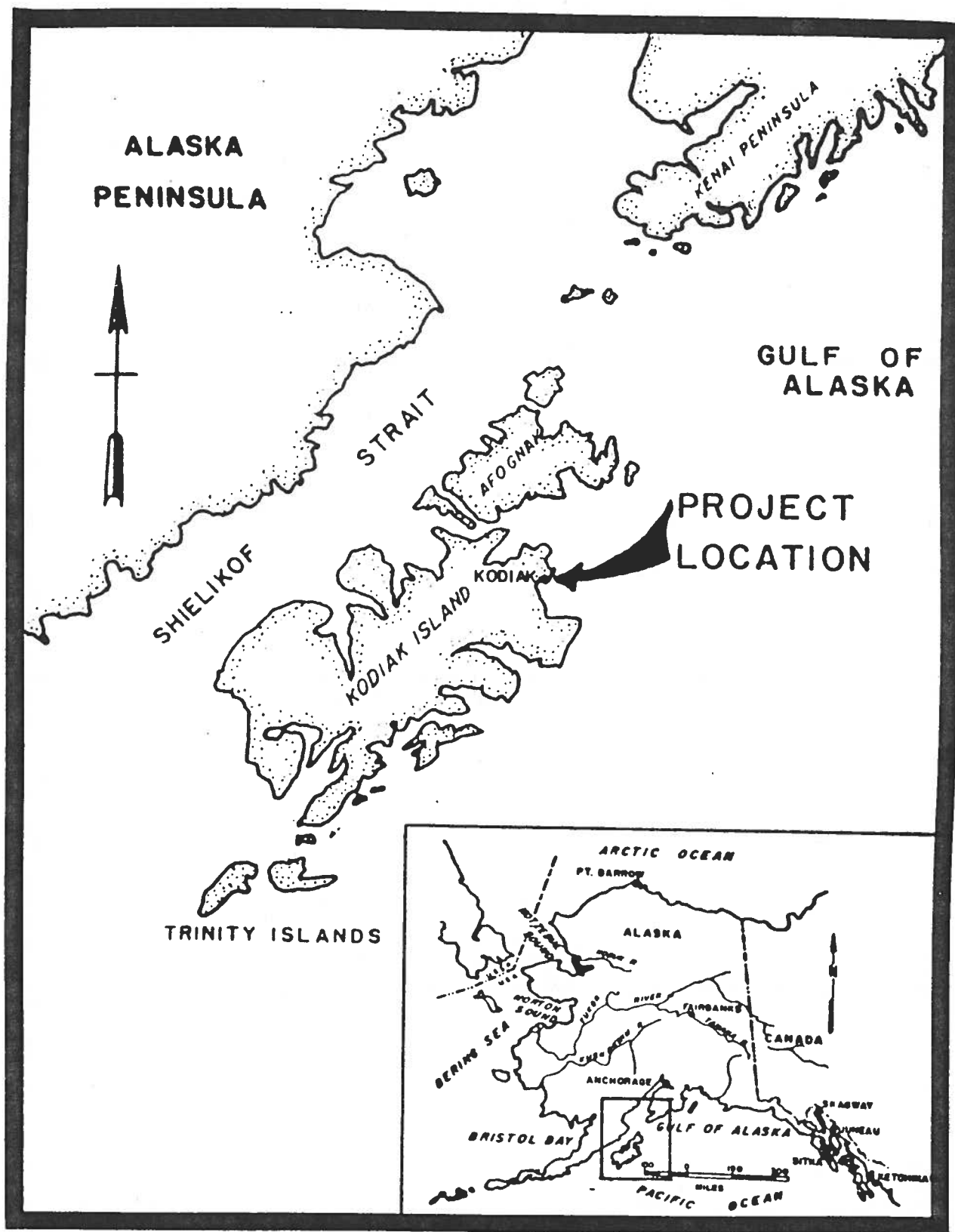


Figure 1. General location of Kodiak National Wildlife Refuge



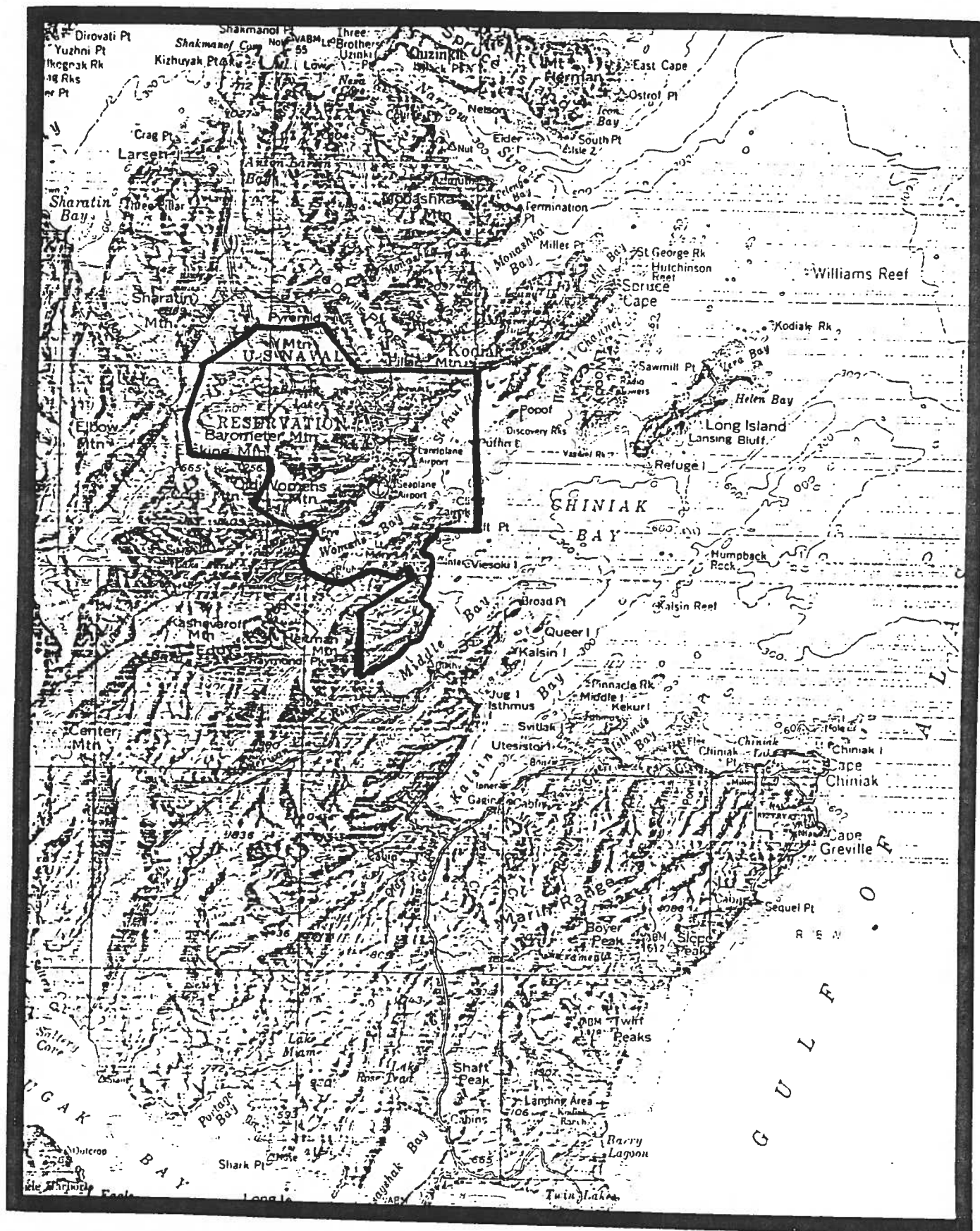


Figure 2. Location of U.S. Naval Reservation

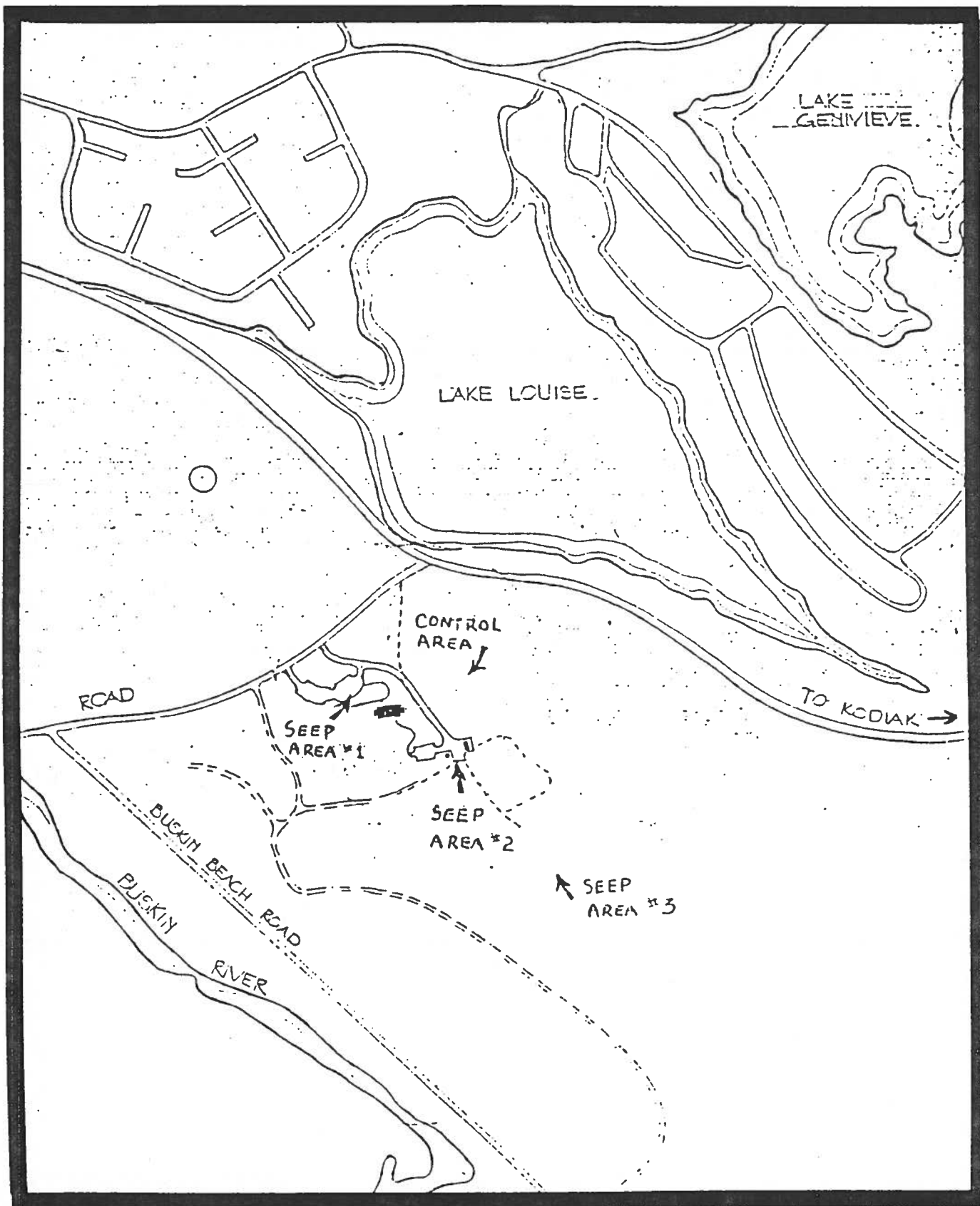


Figure 3. Sample site locations

Table 1. Analytes for the Kodiak Refuge Contaminant Study.

<u>INORGANICS</u>	<u>POLYNUCLEAR AROMATIC HYDROCARBONS</u>	<u>ORGANOCHLORINES</u>
antimony (Sb)	naphthalene	oxychlordane
arsenic (As)	1-methylnaphthalene	cis-nonachlor
cadmium (Cd)	2-methylnaphthalene	alpha chlordane
chromium (Cr)	2,6 dimethylnaphthalene	gamma chlordane
copper (Cu)	2,3,4-trimethylnaphthalene	transnonachlor
iron (Fe)	1-methylphenanthrene	heptachlor
manganese (Mn)	acenaphthylene	heptachlorepoxyde
mercury (Hg)	acenaphthene	o,p'-DDE
nickel (Ni)	fluorene	p,p'-DDE
lead (Pb)	phenanthrene	o,p'-DDD
selenium (Se)	anthracene	p,p'-DDD
thallium (Tl)	fluoranthene	o,p'-DDT
	pyrene	p,p'-DDT
	benzo(a)anthracene	total DDT
	chrysene	mirex
	benzo(b)fluoranthene	dieldrin
	benzo(k)fluoranthene	aldrin
	benzo(e)pyrene	alpha BHC
	benzo(a)pyrene	hexachlorobenzene
	perylene	beta BHC
	indeno(1,2,3-c,d)pyrene	lindane
	dibenzo(a,h)anthracene	delta BHC
	benzo(g,h,i)perylene	total C1-2 (PCB)
	biphenyl	total C1-3 (PCB)
		total C1-4 (PCB)
		total C1-5 (PCB)
		total C1-6 (PCB)
		total C1-7 (PCB)
		total C1-8 (PCB)
		total C1-9 (PCB)
		total PCBs
		toxaphene

TABLE 2. Raw Data for Trace Metals - Kodiak National Wildlife Refuge - 1988<sup>1</sup>

Site <sup>2</sup>	I.D. <sup>3</sup>	Al <sup>4</sup>	Ba	Cr	Cu	Pb	Mn <sup>4</sup>	Ni	Zn	As	Hg	Se
1	AK001S	4.1	196.	25.5	35.5	44.1	6.6	23.9	247.	13.5	ND	1.2
1	AK001S2	4.0	260.	19.8	35.3	88.0	10.0	27.7	299.	14.3	ND	1.2
1	BK001S	4.8	242.	59.8	36.2	269.	7.4	26.4	279.	15.9	ND	1.7
1	BK001S2	3.0	303.	22.4	45.8	51.5	11.8	34.1	525.	15.4	ND	1.5
1	CK001S	5.4	219.	25.6	42.8	28.6	4.2	25.0	233.	16.1	ND	1.4
1	CK001S2	5.7	230.	20.8	44.7	39.8	8.2	24.3	247.	21.9	ND	1.4
2	DK002S	19.1	317.	15.0	11.3	14.3	0.7	7.5	96.	2.5	.04	D.8
2	DK002S2	21.4	332.	18.4	16.9	14.5	0.8	10.5	125.	3.4	.04	D.8
2	EK002S	30.6	355.	19.7	16.7	15.0	0.8	10.3	121.	4.5	.05	D.6
2	EK002S2	32.2	371.	17.5	17.9	16.5	0.8	9.4	132.	3.3	.03	0.9
2	FK002S	18.6	357.	22.3	18.6	14.6	0.8	11.1	139.	4.1	.03	D.6
2	FK002S2	18.0	362.	21.8	19.4	14.8	0.9	10.9	151.	4.3	ND	0.7
3	GK003S	30.6	374.	10.2	ND	ND	0.6	ND	88.	1.8	ND	0.5
3	GK003S2	19.2	367.	13.4	12.5	ND	0.9	7.5	157.	3.1	ND	ND
3	HK003S	23.4	357.	9.1	8.8	ND	0.5	ND	91.	2.1	ND	0.3
3	HK003S2	28.2	394.	12.4	12.3	16.3	0.9	7.2	181.	2.6	ND	ND
3	IK003S	21.1	373.	10.3	8.6	ND	0.6	ND	108.	2.0	ND	0.4
3	IK003S2	23.7	353.	13.5	13.7	ND	0.8	8.2	155.	2.8	ND	0.3
4	JK0040	23.4	328.	23.2	17.7	21.9	0.9	7.2	42.	4.5	.06	D.8
4	JK00402	14.1	233.	13.9	8.3	ND	0.6	ND	28.	5.0	.05	D.7
4	KK0040	16.4	417.	22.5	15.4	20.6	0.8	7.7	50.	3.4	.07	0.5
4	KK00402	14.9	441.	34.5	16.7	14.5	1.0	8.9	54.	6.5	.05	0.6
4	LK0040	11.0	315.	30.4	21.9	15.3	0.8	10.1	53.	3.7	.10	1.0
4	LK00402	11.7	386.	35.0	27.7	19.5	1.2	12.6	59.	4.5	.06	0.5
5	MK005TW	ND	ND	ND	.04	ND	ND	ND	.24	ND	ND	ND
5	MK005TW2	ND	ND	ND	.04	ND	ND	ND	.34	.01	ND	ND

<sup>1</sup> All data are in parts per million (dry wt) unless otherwise noted

<sup>2</sup> Sites 1-3 are seeps; site 4 is a control area;

<sup>3</sup> site 5 is headquarters' drinking water - see Figure 2

<sup>3</sup> Triplicate samples taken twice for sites 1-4; once on 9/9/88, once on 9/25/88

<sup>4</sup> Data are in parts per thousand (dry wt)

# Appendix A. Action Levels : Metals

<u>ELEMENT</u>	<u>CRITERIA<sup>a</sup></u>	
	<u>Water<sup>b</sup></u>	<u>Soil/Sediment<sup>b</sup></u>
Aluminum	400.0 (F); 10. (M)	81000. (F)
Antimony	0.6 (F)	9.0
Arsenic	0.1 (F); 0.02 (M)	64.0
Barium	-----	430.
Beryllium	50.0 (F)	15.0
Boron	12.0 (F)	100.
Cadmium	0.003 (F); 0.009 (M)	6.0 (F); 9.0 (M)
Chromium	0.03 (F); 1.2 (M)	37.0 (F); 128. (M)
Copper	0.01 (F); 0.005 (M)	310.
Lead	0.02 (F); 0.01 (M)	50.0 (F); 104. (M)
Manganese	7.0 (F); 2.0 (M)	1000.
Mercury	0.002 (F); 0.0003 (M)	20.0 (F); 1.0 (M)
Molybdenum	50.0 (F)	100.
Nickel	0.3 (F); 2.0 (M)	100.
Selenium	0.3 (F); 0.4 (M)	10.0
Silver	0.001 (F); 0.01 (M)	2.1
Tin (inorganic)	0.05 (F); 0.3 (M)	200.
(tributyl)	0.00001 (F)	---
Vanadium	1.0 (F); 1.0 (M)	150.
Zinc	20.0 (F); 5.0 (M)	200. (F); 267. (M)

<sup>a</sup> All concentrations are in ppm. Subjective criteria were chosen using best professional judgment after consulting references listed at the end of this appendix. In general, a sample value greater than 10 times a criterion can be cause for concern.

<sup>b</sup> (F) = freshwater; (M) = marine

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